Docket No.: 050389-0053 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of	:	Customer Number: 20277
Kiichi MEGURO, et al.	:	Confirmation Number: 3835
Application No.: 10/510,848	:	Group Art Unit: 1792
Filed: October 13, 2004	:	Examiner: Robert M. Kunemund

For: DIAMOND COMPOSITE SUBSTRATE AND PROCESS FOR PRODUCING THE SAME

APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This Appeal Brief is submitted in support of the Notice of Appeal filed May 24, 2010, wherein Appellant appeals from the Primary Examiner's rejection of claims 1-3, 5-13, 15-23 and 25-29.

Real Party In Interest

This application is assigned to Sumitomo Electric Industries, Ltd. by assignment recorded on October 13, 2004, at Reel 016508, Frame 0296.

Related Appeals and Interferences

To the best of Appellant's and Appellant's representatives' knowledge, there are no related appeals or interferences (see, Related Proceedings Appendix).

Status of Claims

1. Claims canceled: 4, 14 and 24
2. Claims withdrawn from consideration, but not canceled: None
3. Claims pending: 1-3, 5-13, 15-23 and 25-29
4. Claims allowed: None
5. Claims rejected: 1-3, 5-13, 15-23 and 25-28
6. Claims on appeal: 1-3, 5-13, 15-23 and 25-28

Appellant submits that claim 29 has been neither rejected nor indicated allowable.

Status of Amendments

Amendments to the claims were filed on September 8, 2009 in response to the June 9, 2009 Office Action. No amendment has been filed in response to the November 24, 2009 final Office Action.

Summary of Claimed Subject Matter

Independent claim 1 is directed to a diamond composite substrate **2** having a diamond monocrystalline substrate **3** and a diamond polysrystalline film **4**. FIG. 4. The diamond monocrystalline substrate **3** has first and second opposed main faces. The diamond polycrystalline film **4** has crystals with random orientation and laminated on the diamond monocrystalline substrate **3** by a vapor phase synthesis. FIG. 4 and ¶ [0010]. The diamond monocrystalline substrate **3** has a thickness defined by a spacing between the main faces to be at least 0.1 mm and no more 1 mm. ¶ [0013].

Claim 2 recites that a difference between an orientation of the first main face, which has a largest surface area of the diamond monocrystalline substrate **3** and an orientation of a {100} plane is no more than 5 degrees. FIG. 2 and ¶ [0041]. Claim 2 further recites that the diamond polycrystalline film **4** is laminated on the second main face parallel to the first face of the diamond monocrystalline substrate **3**. ¶ [0011].

Claim 3 further limits claim 2 requiring that the first main face of the diamond monocrystalline substrate **3** is the {100} plane. ¶¶ [0012] and [0040]-[0041].

Claim 5 recites that, in claim 1, a thickness of the diamond polycrystalline film **4** laminated over the diamond monocrystalline substrate **3** is at least 0.1 mm and no more than 1 mm. ¶¶ [0014] and [0042].

Claim 6 recites that, in claim 1, a ratio of the thickness of the diamond monocrystalline substrate **3** to the thickness of the diamond polycrystalline film **4** is between 1:1 and 1:4. ¶¶ [0015] and [0042].

Claim 7 recites that, in claim 1, the diamond monocrystalline substrate **3** is made up of a plurality of diamond monocrystals all having a same orientation of the first main face having the largest surface area. FIGS. 3 and 4. Claim 7 further recites the plurality of diamond monocrystals are joined by the diamond polycrystalline film **4** formed by the vapor phase synthesis over the diamond monocrystals. FIGS. 3 and 4, and ¶¶ [0016] and [0043].

Claim 8 recites that, in claim 1, the difference between orientations of faces of the plurality of diamond monocrystals in a direction of rotation with respect to an axis perpendicular to the faces thereof is no more than 2 degrees. Claim 8 further recites the difference between the orientations of the faces of the plurality of diamond monocrystals and the orientation of the {100} plane is no more than 5 degrees. ¶¶ [0017] and [0044].

Claim 9 further limits claim 8, requiring that the orientation of the faces of the plurality of diamond monocrystals is {100}. ¶¶ [0018] and [0044].

Claim 10 further limits claim 7, requiring that a difference in thickness between the respective diamond monocrystals is no more than 10 μm. ¶¶ [0019] and [0045].

Claim 11 further limits claim 7, requiring that a gap between the plurality of diamond monocrystals is no more than 500 μm. ¶¶ [0020] and [0045].

Claim 12 is another independent claim reciting a diamond composite substrate **2**. A diamond monocrystalline substrate **3** has first and second opposed main faces and is made up of a plurality of diamond monocrystals. A difference between orientations of the diamond monocrystals in a direction of rotation with respect to an axis perpendicular to faces of the diamond monocrystals is no more than 2 degrees. A difference between orientations of the faces of the plurality of diamond monocrystals and an orientation of a {100} plane is no more than 5 degrees. The plurality of diamond monocrystals are joined by a diamond polycrystalline film **4**. The diamond polycrystalline film **4** has crystals with random orientation formed by a vapor phase synthesis on the second face parallel to the faces of the plurality of diamond monocrystals. An entire surface of the first main face is integrated by vapor-phase synthesized diamond monocrystals grown using the diamond monocrystalline substrate **3** as a seed crystal. A spacing between the main faces is a thickness of the diamond monocrystalline substrate and at least 0.1 mm and no more than 1 mm. FIGS. 3-4 and ¶¶ [0021] and [0046].

Claim 13 recites that, in claim 12, the orientation of the faces of the plurality of diamond monocrystals is {100}. ¶¶ [0022] and [0046].

Claim 15 recites that, in claim 12, a thickness of the diamond polycrystalline film **4** formed by the vapor phase synthesis over the plurality of diamond monocrystals is at least 0.1 mm and no more than 1 mm. ¶¶ [0024] and [0046].

Claim 16 recites that, in claim 12, a ratio of the thickness of the plurality of diamond monocrystals to the thickness of the diamond polycrystalline film is between 1:1 and 1:4. ¶¶ [0025] and [0046].

Claim 17 recites that, in claim 12, a gap between the plurality of diamond monocrystals is no more than 500 μm. ¶¶ [0026] and [0046].

Claim 18 recites that, in claim 12, a difference in the thickness between the plurality of diamond monocrystals is no more than 10 μm. ¶¶ [0027] and [0046].

Claim 19 recites that, in claim 12, a surface of the diamond polycrystalline film 4 has been polished. ¶¶ [0028] and [0046].

Claim 20 recites that, in claim 12, a surface roughness Rmax of the diamond polycrystalline film is no more than 0.1 μm. ¶¶ [0029] and [0046].

Independent claim 21 recites a method for manufacturing a diamond composite substrate having first and second opposed main faces. The method includes lining up a plurality of diamond monocrystals having a same orientation and forming a diamond polycrystalline film 4 having crystals with random orientation by a vapor phase synthesis over the plurality of diamond monocrystals. The method further includes joining the plurality of diamond monocrystals with the diamond polycrystalline film 4 having crystals with random orientation. The diamond monocrystals have a thickness of at least 0.1 mm and no more than 1 mm. ¶¶ [0030] and [0047].

Claim 22 recites that, in claim 21, a deviation between the respective orientations of the plurality of diamond monocrystals in a direction of rotation with respect to an axis perpendicular to faces thereof having a largest surface area, is no more than 2 degrees. Claim 22 further recites that a difference between orientations of the respective faces of the plurality of diamond monocrystals and an orientation of a {100} plane is no more than 5 degrees. ¶¶ [0031] and [0047].

Claim 23 further limits claim 22 requiring that the face having the largest surface area of the respective faces of the plurality of the diamond monocrystals is the {100} plane. ¶¶ [0032] and [0047].

Claim 25 recites that, in claim 21, a thickness of the diamond polycrystalline film 4 formed by the vapor phase synthesis over the plurality of diamond monocrystals is at least 0.1 mm and no more than 1 mm. ¶¶ [0033] and [0048].

Claim 26 recites that, in claim 21, a ratio of the thickness of the plurality of diamond monocrystals to the thickness of the diamond polycrystalline film is between 1:1 and 1:4. ¶¶ [0034] and [0048].

Claim 27 recites that, in claim 21, a difference in thickness between the plurality of diamond monocrystals is no more than 10 μm. ¶¶ [0035] and [0048].

Claim 28 recites that, in claim 21, a gap between the plurality of diamond monocrystals is no more than 500 μm. ¶¶ [0035] and [0048].

Claim 29 recites that, in claim 21, the diamond polycrystalline film has no monocrystalline layer and is distinct from the diamond monocrystalline substrate in a cross section. ¶ [0056]

Grounds of Rejection to Be Reviewed By Appeal

1) Claims 1, 12, 13, and 21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Japanese Patent Application Publication JP 03-093695 (JP '695) in view of Japanese Patent Application Publication JP 03-075298 (Takahiro).

2) Claims 2, 3, 5-11, 15-20, 22, 23 and 25-28 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over JP '695 in view of Takahiro.

Argument

(1) Independent claim 1 is patentable over JP '695 and Takahiro since neither of the references discloses a diamond *polycrystalline* film.

1-1. References relied upon by the Examiner

JP '695 is directed to a method of forming a polycrystalline diamond layer on the substrate by vapor-phase synthesis. The purpose of JP '695 is to inexpensively provide a high-quality polycrystalline diamond having excellent hardness, toughness, heat conductivity and light permeability by removing specific crystal grains from a polycrystalline diamond layer grown on a substrate by vapor phase synthetic method and then producing a diamond on the substrate. *See*, English Abstract of JP '695. According to the method of JP '695, the polycrystalline diamond is first grown on a non-diamond substrate, such as Si, Mo, or SiC, by using vapor-phase synthesis, such as a plasma CVD method. Diamond grains in the polycrystalline diamond other than diamond grains whose (100) crystal plane is parallel to the substrate intact are then removed. After removing the grains, polycrystalline diamond is grown by vapor-phase synthesis on the substrate having only diamond grains with (100) crystal plane. The grown diamond has high orientation of (100) plane since the strength of the diffraction line of the (4,0,0) face is 20 or more while the strength of the (4,0,0) face of diamond powder in which the diamond grains have random orientation is 7. *See*, page 33, third full paragraph to page 35, second full paragraph of the English Translation of JP '695.

On the other hand, Takahiro is directed to a method of producing single crystal of high-pressure phase substrate, for example, diamond. The purpose of Takahiro is to obtain a large-size single crystal of a high-pressure phase substance. *See* English Abstract. According to the method of Takahiro, a plurality of single crystal diamond plates having the same crystal direction are disposed close to each other. Single crystal diamond is formed on the plurality of single crystal diamond plates by using a vapor phase growth method in order to form a single substrate. *See*, English Abstract.

1-2. The Outline of the Office Action

The Office Action asserted that JP '695 discloses a method of growing a polycrystalline diamond by using a layer of polycrystalline diamond as a nucleation site. The Office Action specifically stated that JP '695 discloses a polycrystalline diamond layer with different orientations, but does not disclose a highly oriented polycrystalline diamond layer.

The Office Action admitted that JP '695 fails to disclose that the nucleation site is a single crystal diamond. Nevertheless, the Office Action relied on Takahiro asserting that Takahiro discloses the use of monocrystalline diamond as a substrate.

The Office Action concluded that it would have been obvious to one of skill in the art to modify the JP '695 with Takahiro to use a single crystal diamond base in order to ensure that the layer of diamonds has uniform orientation.

Further, in the Office Action dated November 24, 2009, it was asserted that the JP '695 reference does not disclose that the grown polycrystal is considered to be highly oriented and discloses that the undesired orientations are removed, but the other orientations are in fact grown (see, page 3, the last full paragraph of the November 24, 2009 Office Action). The Office Action asserted that with respect to the X-ray diffraction strength of 7, there is no evidence that this value (7) is not recognized for polycrystalline diamond layer that is considered randomly oriented (see, page 4, the first full paragraph of the November 24, 2009 Office Action). Moreover, the Office Action stated that "[a]t no time does the reference teach that one cannot use of single crystal diamond, only they are hard to make or that one with ruin the intended use" (see, page 4, the second full paragraph of the November 24, 2009 Office Action).

1-3. JP '695 fails to disclose a diamond polycrystalline film of independent claim 1

JP '695 fails to disclose a diamond polycrystalline film having crystals with random orientation

as recited by independent claim 1. Although JP '695 uses the term "polycrystalline," JP '695 discloses a highly oriented polycrystalline diamond layer, not a diamond polycrystalline film having crystals with random orientation.

The Office Action asserted that the diamond layer of JP '695 is a polycrystalline layer. Although the Office Action acknowledged that JP '695 states that the diamond is high quality, the Office Action found that JP '695 does not disclose that the diamond layer of JP '695 has a highly oriented polycrystalline diamond layer. The Office Action asserted that JP '695 does not use the phrase "highly oriented" stating that JP '695 fails to teach that the grown polycrystalline is considered to be highly oriented. Further, the Office Action found that the undesired orientations are removed but the other orientations are in fact grown.

Appellant submits that JP '695 states, at page 31, third full paragraph of the English Translation of JP '695:

> That is, the present invention relates to a polycrystalline diamond wherein ***the strength of diffraction line of the (4,0,0) face is 20 or more*** when the strength of the diffraction line of the (1,1,1) face by X-ray diffraction is 100, and wherein ***the (4,0,0) face is aligned with the surface of the growth substrate***.(*emphasis added*).

Further, page 35, third full paragraph bridging to page 36 of the English Translation of JP '695 states:

> In a polycrystalline diamond of the present invention obtained by the method described above, the strength of diffraction line of (4,0,0) face is 20 or more when the strength of the diffraction line of the (1,1,1) face by X-ray diffraction is 100. Since according to ASTM X-ray diffraction data the diffraction strength of the (4,0,0) face of diamond powder in which the diamond drains have random orientation is *7* when the (1,0,0) is 100, a value of 20 and more ***indicates strong orientation…*** (*Emphasis added*).

Thus, it is clear that JP '695 disclosed a strongly (highly) oriented polycrystalline-like diamond film on a monocrystalline substrate of Si, Mo or SiC.

The fact that the alleged polycrystalline diamond film of JP '695 is highly oriented is further evidenced by FIG. 3 of JP '695. FIG. 3 of JP '695 illustrates a schematic cross sectional view of the

diamond film 2. Reference numeral 3 (shaded areas) indicates diamond grains (crystals) having (1,0,0) orientation. *See*, page 41, first full paragraph and page 42 of the English Translation of JP '695. Existence of a plurality of grains (shaded areas) means that the film is polycrystalline-like diamond, but each of the grains has (1,0,0) orientation. Thus, it is clear that FIG. 3 of JP '695 indicates that the alleged polycrystalline film of JP '695 has only crystals (or crystal grains) having (1,0,0) orientation.

In contrast, the polycrystalline film of claim 1 has crystals (grains) ***with random orientation***. This means that the polycrystalline film of claim 1 has a plurality of crystal grains with random orientations. By using the polycrystalline film having crystals with random orientation, it is possible to obtain a high toughness diamond composite substrate. *See*, paragraph [0039] of the present application. Appellant also notes that one of ordinary skill in the art would understand and recognize that the term "polycrystalline film" as described in the present disclosure means a film having a plurality of crystal grains with random orientations.

In response to the Appellant's argument, the Office Action found that the undesired orientations are removed, but the other orientations are in fact grown. Appellant disagrees.

Appellant respectfully submits that the diamond film before removing the undesired crystal orientations in JP '695 is different from the claimed polycrystalline film, because the step as illustrated in FIG. 1 of JP '695 is a mere intermediate process step and does not disclose the final structure of JP '695. Further, as the Office Action admitted, the undesired orientations are removed leaving only the (1,0,0) oriented crystals. In other words, even if, *arguendo*, JP '695 was combined with Takahiro, as JP '695 requires removing the undesired orientations, the combination would still fail to disclose or fairly suggest the claimed polycrystalline film having crystals with random orientation. It is clear that the film as illustrated by FIG. 1 of JP '695 could not have been combined with Takahiro because such a combination would impair the intended purpose of the diamond film of JP '695 (obtaining only

(1,0,0) oriented diamonds). *See* M.P.E.P. § 2143.01 ("[T]he claimed combination cannot change the principle of operation of the primary reference or render the reference inoperable for its intended purpose").

As such, it is clear that, at a minimum, JP '695 fails to disclose a polycrystalline film having crystals ***with random orientation*** as recited by independent claim 1. Since Takahiro is directed to a method of producing a single crystal diamond film on a single crystal diamond substrate, it is also clear that Takahiro fails to disclose a polycrystalline film having crystals with random orientation as recited by independent claim 1.

<u>1-4. Combining JP '695 with Takahiro being non-obvious</u>

Appellant respectfully submits that it would not have been obvious to combine JP '695 with Takahiro because there is no motivation or suggestion to do so. Specifically, the combination of JP '695 and Takahiro would impair the intended purposes of both JP '695 and Takahiro (see, M.P.E.P. § 2143.01).

As discussed above, JP '695 is directed to a method of growing a polycrystalline diamond on the substrate by vapor-phase synthesis in order to obtain high quality polycrystalline diamond having a large area at a low cost. JP '695, at page 31, first full paragraph of the English Translation, states:

> The present invention intends to provide, by solving aforementioned problems, high quality polycrystalline diamond superior in hardness, toughness, thermal conductivity and **optical transparency**, and a method of producing the same by using a vapor synthesis method **at a low cost** (*emphasis added*).

Thus, using single crystalline diamond, which are well-known as an expensive material, would impair the intended purpose of JP '695.

Further, JP '695 states, at page 30, first paragraph of the English Translation:

> Natural ***single-crystal diamonds*** and artificial ***single-crystal diamonds*** synthesized under high pressure are currently being used as heatsinks in laser diodes and other semiconductors that require special heat dissipation properties, but such ***single crystal diamonds are extremely difficult to manufacture for***

> ***electronic components, which require areas of at least several square millimeters***, or ***optical components, which require transparency*** (*emphasis added*).

As such, it is clear that JP '695 never intends to use a single crystal diamond substrate to form a polycrystalline diamond layer thereon because of the intended purpose and the above disclosed problems.

In this regard, the Office Action asserted that JP '695 discloses the use of a single crystalline substrate and does not state that it is impossible to use a single crystalline substrate. However, Appellant respectfully submits that the current patent law, rules and prior cases do not hold or even suggest that "teaching away" requires that the combination be impossible or the references be unable to be combined. Rather, as set forth above, it must be considered that proposed modification cannot render the prior art unsatisfactory for its intended purpose or change the principle of operation of a reference, as set forth M.P.E.P. § 2143.01 (see, M.P.E.P. § 2145, X, D). As discussed above, the purpose of JP '695 is to obtain high quality polycrystalline diamond having a large area at a low cost. *See*, page 40, third full paragraph of English translation of JP '695. Since it is clear that a single crystalline diamond substrate is small in size and expensive, using a single crystalline diamond substrate is clearly taught away in JP '695 or renders JP '695 unsatisfactory for its intended purpose. It is also submitted that JP '695 never discloses or suggests that a single crystalline diamond substrate may be used as an alternative. Moreover, Appellant respectfully submits that page 4, the second full paragraph of November 24, 2009 Office Action appears to admit that the utilizing the single crystalline substrate ruins the intended use.

As such, it is clear that JP '695 teaches away from using a single crystalline diamond as the substrate in producing a polycrystalline diamond film. It is also clear that, since the purpose of Takahiro is to obtain single crystal diamond, the method of producing polycrystalline diamond of JP '695 would never be adopted in the technology of Takahiro.

Accordingly, it would not have been obvious to combine JP '695 with Takahiro because there is no motivation or suggestion to do so and JP '695 in fact teaches away from adopting the teachings of Takahiro.

For the foregoing reasons, the rejection does not present a *prima facie* case of obviousness of claim 1 over the combined teachings of JP '695 and Takahiro. Thus, Appellant submits that claim 1 is patentable over the cited references.

(2) Independent claim 12 is patentable over JP '695 and Takahiro since neither of the references discloses a diamond *polycrystalline* film.

2-1. References relied upon by the Examiner

JP '695 is directed to a method of forming a polycrystalline diamond layer on the substrate by vapor-phase synthesis. The purpose of JP '695 is to inexpensively provide a high-quality polycrystalline diamond having excellent hardness, toughness, heat conductivity and light permeability by removing specific crystal grains from a polycrystalline diamond layer grown on a substrate by vapor phase synthetic method and then producing a diamond on the substrate. *See*, English Abstract of JP '695. According to the method of JP '695, the polycrystalline diamond is first grown on a non-diamond substrate, such as Si, Mo, or SiC, by using vapor-phase synthesis, such as a plasma CVD method. Diamond grains in the polycrystalline diamond other than diamond grains whose (100) crystal plane is parallel to the substrate intact are then removed. After removing the grains, polycrystalline diamond is grown by vapor-phase synthesis on the substrate having only diamond grains with (100) crystal plane. The grown diamond has high orientation of (100) plane since the strength of the diffraction line of the (4,0,0) face is 20 or more while the strength of the (4,0,0) face of diamond powder in which the diamond grains have random orientation is 7. *See*, page 33, third full paragraph to page 35, second full paragraph of the English Translation of JP '695.

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2-2. The Outline of the Office Action

The Office Action asserted that JP '695 discloses a method of growing a polycrystalline diamond by using a layer of polycrystalline diamond as a nucleation site. The Office Action specifically stated that JP '695 discloses a polycrystalline diamond layer with different orientations, but does not disclose a highly oriented polycrystalline diamond layer.

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The Office Action concluded that it would have been obvious to one of skill in the art to modify the JP '695 with Takahiro to use a single crystal diamond base in order to ensure that the layer of diamonds has uniform orientation.

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paragraph of the November 24, 2009 Office Action). Moreover, the Office Action stated that "[a]t no time does the reference teach that one cannot use of single crystal diamond, only they are hard to make or that one with ruin the intended use" (see, page 4, the second full paragraph of the November 24, 2009 Office Action).

2-3. JP '695 fails to disclose a diamond polycrystalline film of independent claim 12

JP '695 fails to disclose a diamond polycrystalline film having crystals with random orientation as recited by independent claim 12. Although JP '695 uses the term "polycrystalline," JP '695 discloses a highly oriented polycrystalline diamond layer, not a diamond polycrystalline film having crystals with random orientation.

The Office Action asserted that the diamond layer of JP '695 is a polycrystalline layer. Although the Office Action acknowledged that JP '695 states that the diamond is high quality, the Office Action found that JP '695 does not disclose that the diamond layer of JP '695 has a highly oriented polycrystalline diamond layer. The Office Action asserted that JP '695 does not use the phrase "highly oriented" stating that JP '695 fails to teach that the grown polycrystalline is considered to be highly oriented. Further, the Office Action found that the undesired orientations are removed but the other orientations are in fact grown.

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> is 100. Since according to ASTM X-ray diffraction data the diffraction strength of the (4,0,0) face of diamond powder in which the diamond drains have random orientation is 7 when the (1,0,0) is 100, a value of 20 and more ***indicates strong orientation***... (*Emphasis added*).

Thus, it is clear that JP '695 disclosed a strongly (highly) oriented polycrystalline-like diamond film on a monocrystalline substrate of Si, Mo or SiC.

The fact that the alleged polycrystalline diamond film of JP '695 is highly oriented is further evidenced by FIG. 3 of JP '695. FIG. 3 of JP '695 illustrates a schematic cross sectional view of the diamond film 2. Reference numeral 3 (shaded areas) indicates diamond grains (crystals) having (1,0,0) orientation. *See*, page 41, first full paragraph and page 42 of the English Translation of JP '695. Existence of a plurality of grains (shaded areas) means that the film is polycrystalline-like diamond, but each of the grains has (1,0,0) orientation. Thus, it is clear that FIG. 3 of JP '695 indicates that the alleged polycrystalline film of JP '695 has only crystals (or crystal grains) having (1,0,0) orientation.

In contrast, the polycrystalline film of claim 12 has crystals (grains) ***with random orientation***. This means that the polycrystalline film of claim 12 has a plurality of crystal grains with random orientations. By using the polycrystalline film having crystals with random orientation, it is possible to obtain a high toughness diamond composite substrate. *See*, paragraph [0039] of the present application. Appellant also notes that one of ordinary skill in the art would understand and recognize that the term "polycrystalline film" as described in the present disclosure means a film having a plurality of crystal grains with random orientations.

In response to the Appellant's argument, the Office Action found that the undesired orientations are removed, but the other orientations are in fact grown. Appellant disagrees.

Appellant respectfully submits that the diamond film before removing the undesired crystal orientations in JP '695 is different from the claimed polycrystalline film, because the step as illustrated in FIG. 1 of JP '695 is a mere intermediate process step and does not disclose the final structure of JP

'695. Further, as the Office Action admitted, the undesired orientations are removed leaving only the (1,0,0) oriented crystals. In other words, even if, ***arguendo***, JP '695 was combined with Takahiro, as JP '695 requires removing the undesired orientations, the combination would still fail to disclose or fairly suggest the claimed polycrystalline film having crystals with random orientation. It is clear that the film as illustrated by FIG. 1 of JP '695 could not have been combined with Takahiro because such a combination would impair the intended purpose of the diamond film of JP '695 (obtaining only (1,0,0) oriented diamonds). *See* M.P.E.P. § 2143.01 ("[T]he claimed combination cannot change the principle of operation of the primary reference or render the reference inoperable for its intended purpose").

As such, it is clear that, at a minimum, JP '695 fails to disclose a polycrystalline film having crystals ***with random orientation*** as recited by independent claim 12. Since Takahiro is directed to a method of producing a single crystal diamond film on a single crystal diamond substrate, it is also clear that Takahiro fails to disclose a polycrystalline film having crystals with random orientation as recited by independent claim 12.

2-4. Combining JP '695 with Takahiro being non-obvious

Appellant respectfully submits that it would not have been obvious to combine JP '695 with Takahiro because there is no motivation or suggestion to do so. Specifically, the combination of JP '695 and Takahiro would impair the intended purposes of both JP '695 and Takahiro (see, M.P.E.P. § 2143.01).

As discussed above, JP '695 is directed to a method of growing a polycrystalline diamond on the substrate by vapor-phase synthesis in order to obtain high quality polycrystalline diamond having a large area at a low cost. JP '695, at page 31, first full paragraph of the English Translation, states:

> The present invention intends to provide, by solving aforementioned problems, high quality polycrystalline diamond superior in hardness, toughness, thermal

> conductivity and **optical transparency**, and a method of producing the same by using a vapor synthesis method **at a low cost** (*emphasis added*).

Thus, using single crystalline diamond, which are well-known as an expensive material, would impair the intended purpose of JP '695.

Further, JP '695 states, at page 30, first paragraph of the English Translation:

> Natural ***single-crystal diamonds*** and artificial ***single-crystal diamonds*** synthesized under high pressure are currently being used as heatsinks in laser diodes and other semiconductors that require special heat dissipation properties, but such ***single crystal diamonds are extremely difficult to manufacture for electronic components, which require areas of at least several square millimeters***, or ***optical components, which require transparency*** (*emphasis added*).

As such, it is clear that JP '695 never intends to use a single crystal diamond substrate to form a polycrystalline diamond layer thereon because of the intended purpose and the above disclosed problems.

In this regard, the Office Action asserted that JP '695 discloses the use of a single crystalline substrate and does not state that it is impossible to use a single crystalline substrate. However, Appellant respectfully submits that the current patent law, rules and prior cases do not hold or even suggest that "teaching away" requires that the combination be impossible or the references be unable to be combined. Rather, as set forth above, it must be considered that proposed modification cannot render the prior art unsatisfactory for its intended purpose or change the principle of operation of a reference, as set forth M.P.E.P. § 2143.01 (see, M.P.E.P. § 2145, X, D). As discussed above, the purpose of JP '695 is to obtain high quality polycrystalline diamond having a large area at a low cost. *See*, page 40, third full paragraph of English translation of JP '695. Since it is clear that a single crystalline diamond substrate is small in size and expensive, using a single crystalline diamond substrate is clearly taught away in JP '695 or renders JP '695 unsatisfactory for its intended purpose. It is also submitted that JP '695 never discloses or suggests that a single crystalline diamond substrate

may be used as an alternative. Moreover, Appellant respectfully submits that page 4, the second full paragraph of November 24, 2009 Office Action appears to admit that the utilizing the single crystalline substrate ruins the intended use.

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Accordingly, it would not have been obvious to combine JP '695 with Takahiro because there is no motivation or suggestion to do so and JP '695 in fact teaches away from adopting the teachings of Takahiro.

For the foregoing reasons, the rejection does not present a *prima facie* case of obviousness of claim 12 over the combined teachings of JP '695 and Takahiro. Thus, Appellant submits that claim 12 is patentable over the cited references.

(3) Independent claim 21 is patentable over JP '695 and Takahiro since neither of the references discloses a diamond *polycrystalline* film.

3-1. References relied upon by the Examiner

JP '695 is directed to a method of forming a polycrystalline diamond layer on the substrate by vapor-phase synthesis. The purpose of JP '695 is to inexpensively provide a high-quality polycrystalline diamond having excellent hardness, toughness, heat conductivity and light permeability by removing specific crystal grains from a polycrystalline diamond layer grown on a substrate by vapor phase synthetic method and then producing a diamond on the substrate. *See*, English Abstract of JP '695. According to the method of JP '695, the polycrystalline diamond is first grown on a non-diamond substrate, such as Si, Mo, or SiC, by using vapor-phase synthesis, such as a plasma CVD

method. Diamond grains in the polycrystalline diamond other than diamond grains whose (100) crystal plane is parallel to the substrate intact are then removed. After removing the grains, polycrystalline diamond is grown by vapor-phase synthesis on the substrate having only diamond grains with (100) crystal plane. The grown diamond has high orientation of (100) plane since the strength of the diffraction line of the (4,0,0) face is 20 or more while the strength of the (4,0,0) face of diamond powder in which the diamond grains have random orientation is 7. *See*, page 33, third full paragraph to page 35, second full paragraph of the English Translation of JP '695.

On the other hand, Takahiro is directed to a method of producing single crystal of high-pressure phase substrate, for example, diamond. The purpose of Takahiro is to obtain a large-size <u>single crystal</u> of a high-pressure phase substance. *See* English Abstract. According to the method of Takahiro, a plurality of single crystal diamond plates having the same crystal direction are disposed close to each other. <u>Single crystal diamond</u> is formed on the plurality of single crystal diamond plates by using a vapor phase growth method in order to form a single substrate. *See*, English Abstract.

<u>3-2. The Outline of the Office Action</u>

The Office Action asserted that JP '695 discloses a method of growing a polycrystalline diamond by using a layer of polycrystalline diamond as a nucleation site. The Office Action specifically stated that JP '695 discloses a polycrystalline diamond layer with different orientations, but does not disclose a highly oriented polycrystalline diamond layer.

The Office Action admitted that JP '695 fails to disclose that the nucleation site is a single crystal diamond. Nevertheless, the Office Action relied on Takahiro asserting that Takahiro discloses the use of monocrystalline diamond as a substrate.

The Office Action concluded that it would have been obvious to one of skill in the art to modify the JP '695 with Takahiro to use a single crystal diamond base in order to ensure that the layer

of diamonds has uniform orientation.

Further, in the Office Action dated November 24, 2009, it was asserted that the JP '695 reference does not disclose that the grown polycrystal is considered to be highly oriented and discloses that the undesired orientations are removed, but the other orientations are in fact grown (see, page 3, the last full paragraph of the November 24, 2009 Office Action). The Office Action asserted that with respect to the X-ray diffraction strength of 7, there is no evidence that this value (7) is not recognized for polycrystalline diamond layer that is considered randomly oriented (see, page 4, the first full paragraph of the November 24, 2009 Office Action). Moreover, the Office Action stated that "[a]t no time does the reference teach that one cannot use of single crystal diamond, only they are hard to make or that one with ruin the intended use" (see, page 4, the second full paragraph of the November 24, 2009 Office Action).

<u>3-3. JP '695 fails to disclose a diamond polycrystalline film of independent claim 21</u>

JP '695 fails to disclose forming a diamond polycrystalline film having crystals with random orientation as recited by independent claim 21. Although JP '695 uses the term "polycrystalline," JP '695 discloses a highly oriented polycrystalline diamond layer, not a diamond polycrystalline film having crystals with random orientation.

The Office Action asserted that the diamond layer of JP '695 is a polycrystalline layer. Although the Office Action acknowledged that JP '695 states that the diamond is high quality, the Office Action found that JP '695 does not disclose that the diamond layer of JP '695 has a highly oriented polycrystalline diamond layer. The Office Action asserted that JP '695 does not use the phrase "highly oriented" stating that JP '695 fails to teach that the grown polycrystalline is considered to be highly oriented. Further, the Office Action found that the undesired orientations are removed but the other orientations are in fact grown.

Appellant submits that JP '695 states, at page 31, third full paragraph of the English Translation of JP '695:

> That is, the present invention relates to a polycrystalline diamond wherein ***the strength of diffraction line of the (4,0,0) face is 20 or more*** when the strength of the diffraction line of the (1,1,1) face by X-ray diffraction is 100, and wherein ***the (4,0,0) face is aligned with the surface of the growth substrate***.(*emphasis added*).

Further, page 35, third full paragraph bridging to page 36 of the English Translation of JP '695 states:

> In a polycrystalline diamond of the present invention obtained by the method described above, the strength of diffraction line of (4,0,0) face is 20 or more when the strength of the diffraction line of the (1,1,1) face by X-ray diffraction is 100. Since according to ASTM X-ray diffraction data the diffraction strength of the (4,0,0) face of diamond powder in which the diamond drains have random orientation is 7 when the (1,0,0) is 100, a value of 20 and more ***indicates strong orientation***... (*Emphasis added*).

Thus, it is clear that JP '695 disclosed a strongly (highly) oriented polycrystalline-like diamond film on a monocrystalline substrate of Si, Mo or SiC.

The fact that the alleged polycrystalline diamond film of JP '695 is highly oriented is further evidenced by FIG. 3 of JP '695. FIG. 3 of JP '695 illustrates a schematic cross sectional view of the diamond film 2. Reference numeral 3 (shaded areas) indicates diamond grains (crystals) having (1,0,0) orientation. *See*, page 41, first full paragraph and page 42 of the English Translation of JP '695. Existence of a plurality of grains (shaded areas) means that the film is polycrystalline-like diamond, but each of the grains has (1,0,0) orientation. Thus, it is clear that FIG. 3 of JP '695 indicates that the alleged polycrystalline film of JP '695 has only crystals (or crystal grains) having (1,0,0) orientation.

In contrast, the polycrystalline film of claim 21 has crystals (grains) ***with random orientation***. This means that the polycrystalline film of claim 21 has a plurality of crystal grains with random orientations. By using the polycrystalline film having crystals with random orientation, it is possible to obtain a high toughness diamond composite substrate. *See*, paragraph [0039] of the present application. Appellant also notes that one of ordinary skill in the art would understand and recognize that the term

"polycrystalline film" as described in the present disclosure means a film having a plurality of crystal grains with random orientations.

In response to the Appellant's argument, the Office Action found that the undesired orientations are removed, but the other orientations are in fact grown. Appellant disagrees.

Appellant respectfully submits that the diamond film before removing the undesired crystal orientations in JP '695 is different from the claimed polycrystalline film, because the step as illustrated in FIG. 1 of JP '695 is a mere intermediate process step and does not disclose the final structure of JP '695. Further, as the Office Action admitted, the undesired orientations are removed leaving only the (1,0,0) oriented crystals. In other words, even if, *arguendo*, JP '695 was combined with Takahiro, as JP '695 requires removing the undesired orientations, the combination would still fail to disclose or fairly suggest the claimed polycrystalline film having crystals with random orientation. It is clear that the film as illustrated by FIG. 1 of JP '695 could not have been combined with Takahiro because such a combination would impair the intended purpose of the diamond film of JP '695 (obtaining only (1,0,0) oriented diamonds). *See* M.P.E.P. § 2143.01 ("[T]he claimed combination cannot change the principle of operation of the primary reference or render the reference inoperable for its intended purpose").

As such, it is clear that, at a minimum, JP '695 fails to disclose forming a polycrystalline film having crystals ***with random orientation*** as recited by independent claim 21. Since Takahiro is directed to a method of producing a single crystal diamond film on a single crystal diamond substrate, it is also clear that Takahiro fails to disclose forming a polycrystalline film having crystals with random orientation as recited by independent claim 21.

3-4. Combining JP '695 with Takahiro being non-obvious

Appellant respectfully submits that it would not have been obvious to combine JP '695 with

Takahiro because there is no motivation or suggestion to do so. Specifically, the combination of JP '695 and Takahiro would impair the intended purposes of both JP '695 and Takahiro (see, M.P.E.P. § 2143.01).

As discussed above, JP '695 is directed to a method of growing a polycrystalline diamond on the substrate by vapor-phase synthesis in order to obtain high quality polycrystalline diamond having a large area at a low cost. JP '695, at page 31, first full paragraph of the English Translation, states:

> The present invention intends to provide, by solving aforementioned problems, high quality polycrystalline diamond superior in hardness, toughness, thermal conductivity and **optical transparency**, and a method of producing the same by using a vapor synthesis method **at a low cost** (*emphasis added*).

Thus, using single crystalline diamond, which are well-known as an expensive material, would impair the intended purpose of JP '695.

Further, JP '695 states, at page 30, first paragraph of the English Translation:

> Natural ***single-crystal diamonds*** and artificial ***single-crystal diamonds*** synthesized under high pressure are currently being used as heatsinks in laser diodes and other semiconductors that require special heat dissipation properties, but such ***single crystal diamonds are extremely difficult to manufacture for electronic components, which require areas of at least several square millimeters***, or ***optical components, which require transparency*** (*emphasis added*).

As such, it is clear that JP '695 never intends to use a single crystal diamond substrate to form a polycrystalline diamond layer thereon because of the intended purpose and the above disclosed problems.

In this regard, the Office Action asserted that JP '695 discloses the use of a single crystalline substrate and does not state that it is impossible to use a single crystalline substrate. However, Appellant respectfully submits that the current patent law, rules and prior cases do not hold or even suggest that "teaching away" requires that the combination be impossible or the references be unable to be combined. Rather, as set forth above, it must be considered that proposed modification cannot

render the prior art unsatisfactory for its intended purpose or change the principle of operation of a reference, as set forth M.P.E.P. § 2143.01 (see, M.P.E.P. § 2145, X, D). As discussed above, the purpose of JP '695 is to obtain high quality polycrystalline diamond having a large area at a low cost. *See*, page 40, third full paragraph of English translation of JP '695. Since it is clear that a single crystalline diamond substrate is small in size and expensive, using a single crystalline diamond substrate is clearly taught away in JP '695 or renders JP '695 unsatisfactory for its intended purpose. It is also submitted that JP '695 never discloses or suggests that a single crystalline diamond substrate may be used as an alternative. Moreover, Appellant respectfully submits that page 4, the second full paragraph of November 24, 2009 Office Action appears to admit that the utilizing the single crystalline substrate ruins the intended use.

As such, it is clear that JP '695 teaches away from using a single crystalline diamond as the substrate in producing a polycrystalline diamond film. It is also clear that, since the purpose of Takahiro is to obtain single crystal diamond, the method of producing polycrystalline diamond of JP '695 would never be adopted in the technology of Takahiro.

Accordingly, it would not have been obvious to combine JP '695 with Takahiro because there is no motivation or suggestion to do so and JP '695 in fact teaches away from adopting the teachings of Takahiro.

For the foregoing reasons, the rejection does not present a *prima facie* case of obviousness of claim 21 over the combined teachings of JP '695 and Takahiro. Thus, Appellant submits that claim 21 is patentable over the cited references.

(4) Dependent claims 2, 3, 5-11, 13, 15-20, 22, 23 and 25-28 are patentable over JP '695 and Takahiro.

Under Federal Circuit guidelines, a dependent claim is nonobvious if the independent claim

upon which it depends is allowable because all the limitations of the independent claim are contained in the dependent claims, *Hartness International Inc. v. Simplimatic Engineering Co.*, 819 F.2d at 1100, 1108 (Fed. Cir. 1987). Accordingly, since claims 1, 12 and 21 are patentable as set forth above, dependent claim 2, 3, 5-11, 13, 15-20, 22, 23 and 25-28 are patentable for at least the same reasons as for the independent claims.

Conclusion

For all of the foregoing reason, Appellant respectfully submits that the grounds of rejection of the claims on appeal are in error and should be reversed.

Respectfully submitted,

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CLAIMS APPENDIX

1. A diamond composite substrate, comprising:

a diamond monocrystalline substrate having first and second opposed main faces; and

a diamond polycrystalline film having crystals with random orientation laminated thereon by a vapor phase synthesis,

wherein the diamond monocrystalline substrate having a thickness defined by a spacing between the main faces to be at least 0.1 mm and no more 1 mm.

2. A diamond composite substrate according to claim 1, wherein a difference between an orientation of the first main face, which has a largest surface area of the diamond monocrystalline substrate and an orientation of a {100} plane is no more than 5 degrees, and

the diamond polycrystalline film is laminated on the second main face parallel to the first face.

3. A diamond composite substrate according to claim 2, wherein the first main face is the {100} plane.

5. A diamond composite substrate according to claim 1, wherein a thickness of the diamond polycrystalline film laminated over the diamond monocrystalline substrate is at least 0.1 mm and no more than 1 mm.

6. A diamond composite substrate according to claim 1, wherein a ratio of the thickness of the diamond monocrystalline substrate to the thickness of the diamond polycrystalline film is between 1:1 and 1:4.

7. A diamond composite substrate according to claim 1, wherein the diamond monocrystalline substrate is made up of a plurality of diamond monocrystals all having a same orientation of the first main face having the largest surface area, and

the plurality of diamond monocrystals are joined by the diamond polycrystalline film formed by the vapor phase synthesis over the diamond monocrystals.

8. A diamond composite substrate according to claim 1 wherein the difference between orientations of faces of the plurality of diamond monocrystals in a direction of rotation with respect to an axis perpendicular to the faces thereof is no more than 2 degrees, and

the difference between the orientations of the faces of the plurality of diamond monocrystals and the orientation of the {100} plane is no more than 5 degrees.

9. A diamond composite substrate according to claim 8, wherein the orientation of the faces of the plurality of diamond monocrystals is {100}.

10. A diamond composite substrate according to claim 7, wherein a difference in thickness between the respective diamond monocrystals is no more than 10 μm.

11. A diamond composite substrate according to claim 7, wherein a gap between the plurality of diamond monocrystals is no more than 500 μm.

12. A diamond composite substrate, wherein a diamond monocrystalline substrate having first and second opposed main faces is made up of a plurality of diamond monocrystals in which a difference

between orientations of the diamond monocrystals in a direction of rotation with respect to an axis perpendicular to faces of the diamond monocrystals is no more than 2 degrees,

a difference between orientations of the faces of the plurality of diamond monocrystals and an orientation of a {100} plane is no more than 5 degrees, the plurality of diamond monocrystals are joined by a diamond polycrystalline film having crystals with random orientation formed by a vapor phase synthesis on the second face parallel to the faces of the plurality of diamond monocrystals,

an entire surface of the first main face is integrated by vapor-phase synthesized diamond monocrystals grown using the diamond monocrystalline substrate as a seed crystal, and

a spacing between the main faces is a thickness of the diamond monocrystalline substrate and at least 0.1 mm and no more than 1 mm.

13. A diamond composite substrate according to claim 12, wherein the orientation of the faces of the plurality of diamond monocrystals is {100}.

15. A diamond composite substrate according to claim 12 , wherein a thickness of the diamond polycrystalline film formed by the vapor phase synthesis over the plurality of diamond monocrystals is at least 0.1 mm and no more than 1 mm.

16. A diamond composite substrate according to claim 12, wherein a ratio of the thickness of the plurality of diamond monocrystals to the thickness of the diamond polycrystalline film is between 1:1 and 1:4.

17. A diamond composite substrate according to claim 12, wherein a gap between the plurality of

diamond monocrystals is no more than 500 μm.

18. A diamond composite substrate according to claim 12, wherein a difference in the thickness between the plurality of diamond monocrystals is no more than 10 μm.

19. A diamond composite substrate according to claim 12, wherein a surface of the diamond polycrystalline film has been polished.

20. A diamond composite substrate according to claim 12, wherein a surface roughness Rmax of the diamond polycrystalline film is no more than 0.1 μm.

21. A method for manufacturing a diamond composite substrate having first and second opposed main faces,

lining up a plurality of diamond monocrystals having a same orientation;

forming a diamond polycrystalline film having crystals with random orientation by a vapor phase synthesis over the plurality of diamond monocrystals; and

joining the plurality of diamond monocrystals with the diamond polycrystalline film having crystals with random orientation,

wherein the diamond monocrystals have a thickness of at least 0.1 mm and no more than 1 mm.

22. A method for manufacturing a diamond composite substrate according to claim 21, wherein a deviation between the respective orientations of the plurality of diamond monocrystals in a direction of rotation with respect to an axis perpendicular to faces thereof having a largest surface area, is no more

than 2 degrees, and a difference between orientations of the respective faces of the plurality of diamond monocrystals and an orientation of a {100} plane is no more than 5 degrees.

23. A method for manufacturing a diamond composite substrate according to claim 22, wherein the face having the largest surface area of the respective faces of the plurality of the diamond monocrystals is the {100} plane.

25. A method for manufacturing a diamond composite substrate according to claim 21, wherein a thickness of the diamond polycrystalline film formed by the vapor phase synthesis over the plurality of diamond monocrystals is at least 0.1 mm and no more than 1 mm.

26. A method for manufacturing a diamond composite substrate according to claim 21, wherein a ratio of the thickness of the plurality of diamond monocrystals to the thickness of the diamond polycrystalline film is between 1:1 and 1:4.

27. A method for manufacturing a diamond composite substrate according to claim 21, wherein a difference in thickness between the plurality of diamond monocrystals is no more than 10 μm.

28. A method for manufacturing a diamond composite substrate according to claim 21, wherein a gap between the plurality of diamond monocrystals is no more than 500 μm.

29. A diamond composite substrate according to claim 1, wherein the diamond polycrystalline film has no monocrystalline layer and is distinct from the diamond monocrystalline substrate in a cross section.

RELATED PROCEEDINGS APPENDIX

To the best of Appellant's and Appellant's representatives' knowledge, there are no related appeals or interferences.

EVIDENCE APPENDIX

Full English translations of JP H03-093695 and JP H03-075298 have been provided as evidence during prosecution of this application.